



February 22, 1972

DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION SPECIFICATION

ELECTRICAL INSULATING GLOVES/TRANSFORMER LIQUIDS TESTER

1. SCOPE

1.1 Scope.- The instrument described herein is a portable 120 volt, 60 Hz, single phase, AC powered, electrical test set that will be used for performing field proof tests and breakdown voltage tests on electrical (rubber) insulating gloves, and for testing the dielectric strength of electrical transformer liquids.

It is the intention of the government to procure readily available commercial equipment or commercial models which can be readily and economically modified by the contractor to meet the requirements of this specification.

2. APPLICABLE SPECIFICATIONS

2.1 FAA Standard.- The following FAA standard, of the issue specified in the invitation for bids, forms a part of this specification:

FAA-STD-013 Quality Control Program Requirements

2.2 Military documents.- The following Military specification and standard, of the issue in effect on date of the invitation for bids or request for proposals, forms a part of this specification to the extent specified herein:

MIL-E-17555 Electronic and Electrical Equipment
and Associated Repair Parts, Preparation
for Delivery of

MIL-STD-454 Standard General Requirements for
Electrical Equipment

2.3 Other publications.- The following documents form a part of this specification to the extent specified herein:

ASTM D-120-70 Standard Specification for Rubber
Insulating Gloves

ASTM D-877-67 Standard Method of Test for
Dielectric Breakdown Voltage of
Insulating Liquids Using Disk
Electrodes

(Copies of this specification and the applicable FAA standard may be obtained from the Federal Aviation Administration, Washington, D. C. 20591, Attention: Contracting Officer. Requests should fully identify material desired, i.e., specification numbers, dates, amendment numbers, complete drawing numbers; also, requests should state the contract involved or other use to be made of the requested material.)

(Single copies of Military specifications and standards may be requested by mail or telephone from U. S. Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120. For telephone requests call 215-697-3321, 8 a.m. to 4:30 p.m., Monday through Friday. Not more than five items may be ordered on a single request, and the Invitation for Bid or Contract Number should be cited where applicable.)

(Copies of ASTM publications may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 Equipment to be furnished by contractor.- Each test set furnished by the contractor shall be complete in accordance with all specification requirements. The test set shall consist of an insulating liquids tester and a glove testing device, complete with carrying cases. Each test set shall be supplied with two instruction books (Para. 3.6).

3.2 Design.- The test set shall be of a design that affords the operator full protection in the performance of its use and shall provide a positive means to automatically de-energize and ground the high voltage section at the termination of each breakdown test.

The test shall be designed for performing:

- (a) High voltage AC proof tests on rubber insulating gloves (ASTM: D-120-70)
- (b) Current proof tests (at the AC high voltage proof-test voltage) on rubber gloves (ASTM: D-120-70)
- (c) High voltage AC breakdown tests on rubber insulating gloves (ASTM: D-120-70)
- (d) Routine dielectric breakdown voltage tests on insulating liquids using disc type electrodes (ASTM: D-877-67).

3.2.1 Electrical Requirements.- The test set shall operate on an input voltage of 120 volts, plus or minus ten percent, 60 Hz single phase alternating current and shall have been designed to function safely over the entire range of required test voltages and currents for test durations in excess of three minutes for proof tests and for repeated dielectric strength tests at frequencies of one (1) minute intervals.

3.2.1.1 Maximum Test Ranges.- The test set shall be capable of operating normally and without injury to the testing apparatus over the following voltage and current test ranges:

- a. Liquid Tests 40,000 volts AC RMS maximum
- b. Glove Tests 30,000 volts AC RMS maximum
20 milliamperes maximum

3.2.2 Normal operating conditions.- The term operating conditions is defined as follows:

Ambient Operation Range 15°C. to 45°C.
Relative Humidity Range 5 per cent thru 95 per cent.

3.2.3 Workmanship.- Workmanship shall be in accordance with MIL-STD-454, Requirement 9.

3.3 Insulating Liquids Tester.- The insulating liquids tester shall include but need not be limited to the following features: a step-up transformer, voltage control equipment, circuit interrupting equipment, a test control panel, a liquids test chamber, and a set of glove test terminals.

3.3.1 Step-Up Transformer.- The step-up transformer shall be of such design and size to provide a high voltage output of at least 40 kilovolts, 60 Hz single phase. The crest factor of the 60 Hz test voltage, with the test specimen in the circuit, shall not differ by more than plus or minus five per cent from that of a sinusoidal wave over the upper half of the range of test voltage. The rating of the step-up transformer shall be sufficient to insure (a) breakdown testing of transformer oils and askerals, and (b) breakdown and proof testing of Class III electrical insulating gloves in accordance with the prescribed test procedures (Para. 3.6 Instruction books).

3.3.2 Voltage Control Equipment.- The voltage control equipment shall consist of a variable auto transformer that shall be manually operable from the control panel by means of a voltage control dial. The voltage control dial shall enable the operator to adjust the output of the auto transformer over the output range of the tester. There shall be sufficient internal resistance to the mechanical movements of the voltage control equipment to prevent accidental or unintentional change to the setting of the voltage control equipment; however, the mechanical resistance shall not preclude the operator from adjusting the movements firmly and smoothly from zero to maximum. The recommended rate(s) of voltage rise shall be included in the operational instructions of the instruction book.

3.3.3 Circuit Interrupting Equipment.- The Insulating Liquids Tester shall be protected by an automatic circuit-breaking device capable of opening the primary step-up transformer circuit in three (3) cycles or less on the current produced by breakdown of the test specimen. The current sensing element that trips the circuit breaker shall operate when:

- a. the current in the insulating liquids test circuit is in the range of 2 to 20 milliamperes; or
- b. the current in the glove test circuit exceeds 20 milliamperes.

Upon breakdown of the test specimen, the high voltage circuits shall be automatically de-energized and the primary winding of the step-up transformer short circuited and grounded. Before the high voltage circuits can be re-activated, the voltage control dial must be returned to the minimum (zero) position.

A re set breaker shall be provided on the control panel to re-energize the primary circuit (See paragraph 3.3.4.2).

3.3.4 Control Panel.- The control panel shall be constructed of steel or aluminum with a minimum thickness of (1/8) one-eighth inch. The panel material shall be painted with a durable baked on acrylic enamel finish. The control panel shall be housed in the insulating liquids tester case and shall be grounded via the power cord ground circuit. The control panel shall include as a minimum the following items:

1. Power On - Off Breaker
2. Circuit Reset Breaker
3. High Voltage Indicator Light (red bezel)
4. Kilovoltmeter (memory type)
5. Voltage Control Dial
6. Warning Sign

The following required items may be located on the control panel or on the electrical contact frame of the Glove Testing device (Para. 3.4.3).

1. Micro-milliammeter
2. Current Range Switch

3.3.4.1 Power On - Off Breaker.- A power On - Off breaker shall be furnished and mounted on the control panel. The breaker shall control the power in the primary circuit of the step up transformer within the instrument and the power to all other circuits. The safety disconnect shall be such that the power drain shall not exceed 125 per cent of the step up transformer rating.

3.3.4.2 Circuit Re-Set Breaker.- A Re-Set breaker shall be furnished and mounted on the control panel. The breaker shall be incorporated in the primary circuit of the step up transformer within the instrument and shall reestablish circuit continuity only when conditions as described in paragraph 3.3.3 are met.

3.3.4.3 High Voltage Indicator Light.- A red jeweled indicator light and receptacle shall be furnished and mounted on the control panel to indicate when high voltage is present. The lamp shall be wired to light-up when the primary circuit has power applied to the step-up transformer.

3.3.4.4 Kilovoltmeter.- A 3½ inch memory type kilovoltmeter with a 0 - 50 scale shall be furnished and mounted on the control panel. The meter shall indicate the peak high voltage applied across the terminals of the liquids test chamber and the external glove test terminals. The voltmeter shall have a combined accuracy of the voltmeter and voltage divider circuit of plus or minus two percent and the meter indication shall be accurate to within plus or minus three percent of the delivered output voltage at maximum burden.

3.3.4.5 Voltage Control Dial.- A voltage control dial shall be furnished and mounted on the control panel. It shall be possible by varying the control to provide continuous adjustment of the output voltage from zero to maximum. The dial shall be linearly divided into one KV increments from 0 to 40 and have emphasis marks provided at every five divisions. Each emphasis mark shall be surmounted with its respective (numbered) dial value.

3.3.4.6 Warning Sign.- The control panel shall prominently display a warning sign as follows:

WARNING

High Voltage (up to 40,000 volts) are used in this equipment. Use extreme CAUTION when operating the unit. Make certain that this tester and test specimen are properly grounded.

3.3.4.7 Micro-Milliammeter.- A 3½ inch, 2 percent accuracy micro-milliammeter shall be furnished and may be mounted on the control panel or the electrical contact frame. The meter shall indicate the current flowing in the glove test circuits of the instrument. It shall be possible to measure 300 microamperes full scale, and 30 milliamperes full scale. The scale shall be linearly divided into equally spaced divisions with emphasis marks provided every five divisions. The micro-milliammeter shall be wired in series with the ground electrode of the test specimen circuits and shunted so that the meter can be activated only by manually engaging the "push-to-read" contacts.

The ammeter may be either internally or externally wired with resistive loads to protect the meter when operating on the selected scale.

3.3.4.8 Circuit Range Switch.- A circuit range switch shall be furnished and mounted adjacent to the ammeter. The switch shall have contacts and circuitry to achieve two (2) range positions and "push-to-read" contacts.

Position 1. 0 - 300 microampers full scale

Position 2 0 - 30 milliamperes full scale

3.3.5 Liquids Test Chamber.- A liquid test chamber shall be an integrally built-in compartment of the tester case, and shall include a liquids test cup, an electrode gauge, a transparent protective cover and a safety switch.

3.3.5.1 Test Cups.- Test cups having rigidly mounted electrodes with parallel faces and axes in a coincident horizontal line shall be made in accordance with ASTM-D-877. The cups shall be easily removable from the test chamber and shall be constructed so that no part of it is less than one-half inch from any part of the test electrode disk. It shall be made of a material of a high dielectric strength and shall not be attacked by any of the recommended cleaning or test liquids. The top of each cup should be about one and one-quarter inches above the top of the electrodes. The cup shall be of a design which permits easy removal of the electrodes for cleaning, polishing, and readjustment of the gap spacing.

Two cups shall be provided with each test set. One may be packaged in the test chamber whereas a separate storage compartment shall be provided in one of the carrying cases for storing and transporting the second cup.

3.3.5.2 Electrode Gauge.- The electrode gauge shall be a standard round gauge of 0.100 inch, plus or minus 0.0005 inches, (2.54 millimeters, plus or minus 0.013 millimeters) or a set of flat steel "go and no go" gauges having thickness of 0.0995 and 0.1005 inches (2.527 and 2.553 millimeters) respectively.

The gauge shall be conveniently and firmly stored inside the test chamber when not being used. The gauge shall be used for setting the electrodes to the standard one-tenth inch test gap.

3.3.5.3 Protective Cover.- The test chamber shall be equipped with a transparent protective cover that is hinged from the tester housing or case and held in place by means of an appropriate safety catch.

3.3.5.4 Safety Switch.- A safety switch shall be mounted in such a manner that whenever the protective cover is in any position other than the closed position, the primary power circuit to the step-up transformer shall be interrupted and short circuited to preclude energizing the step up transformer.

3.3.6 Output Terminals.- The tester shall be equipped with a set of high voltage output terminals to accommodate the test cup (paragraph 3.3.5.1) and a set of external glove test receptacles which will facilitate using the tester in conjunction with the glove testing device (paragraph 3.4).

3.3.6.1 External Glove Test Receptacles.- The external glove test receptacles shall be furnished and recessed in the far vertical (back) side of the Insulating Liquids Tester enclosure. The receptacles shall be of a high voltage feed through type with proper voltage rating and design to handle the maximum output voltage of the test set in the glove test mode. The receptacles shall be (1) inherently corona free, (2) resistive to current leakage even under adverse ambient conditions, (3) color distinctive (red for "hot" lead and black for "ground" lead), and (4) individually distinguishable and compatible to receive only the correct lead connector described in paragraph 3.4.4.

The receptacles shall also be provided with an interlocking transfer switch and circuitry for transferring the high voltage output from the liquids testing mode to the glove testing mode. The switching arrangement shall be such that both "hot" and "ground" leads must be fully engaged to activate the transfer circuit and effect the transfer of the high voltage output from the normally active, liquids testing mode.

3.3.7 Input Power Cable.- The contractor shall furnish a 120 V AC, Type SO, flexible, input power cable 12 foot long, equipped with a three prong 120 V AC connector suitable for connecting the cable to a standard three prong convenience outlet. The cable may be permanently attached to the tester. Where a separate input power cable is furnished, appropriate cable connectors and an input terminal receptacle mounted on the tester shall be furnished by the contractor.

3.4 Glove Testing Device.- The glove testing device shall be an accessory item which can be readily used in conjunction with the basic tester. The item shall consist of a test tank, a glove harness, an electrical contact frame, a set of high voltage test leads, and a carrying case (Para. 3.5) for transporting and storing the device while not being used.

3.4.1 Test Tank.- The test tank shall be a rigid, readily available commercial-type container of such a size to accommodate a Class 3 rubber (electrical) insulating glove when filled with water and arranged in a test position. The size of the container shall be of a sufficient size to assure minimum clearance of: (1) One inch at the bottom, (2) One-half inch to the side walls, and (3) One and one-half inches between the top of the positioned glove and the top of the container.

The container may be molded, extruded or fabricated from glass, hard plastic, or noncorrosive metal subject to advanced approval by the government. Where a metal container is used to satisfy this requirement, the "ground" test lead shall be secured or attached to the metal container such that the container shall afford a low impedance path for the flow of electrical current to the "ground" electrode (water outside the test glove).

Where other than a metal container is supplied, the electrical contact used to energize the ground electrode shall be of substantial design that shall afford a low impedance path for the flow of electrical current.

The container shall be of rigid construction and shall not deform under normal handling or use nor should a build-up of temperature due to repetitive testing cause or bring about any physical changes to the test container.

3.4.2 Glove Harness.- A glove harness shall be provided which shall support, hold, or suspend the glove in a stable test position for the duration of the required tests.

3.4.3 Electrical Contact Frame.- An electrical contact frame shall be provided which shall be supported on and by the test tank. The "hot" electrical contact shall be rigidly attached to the frame and shall be an integral part of the electrical contact frame. The "hot" electrical contact shall provide a low impedance path for the flow of electrical current to the "hot" electrode (the water inside the test glove).

Where other than a metal container is used for the test tank, the "ground" electrical contact (described in paragraph 3.4.1) shall also be an integral part of the electrical contact frame.

Subject to prior approval by the government, the electrical contact frame and the glove harness (paragraph 3.4.2) may be combined into a unified assembly.

3.4.4 Glove Test Leads.- A set of glove test leads shall be provided with each glove testing device. The breakdown voltage of the glove test leads shall be well in excess of the maximum operating voltage and shall be designed to withstand the full range of temperature and humidity expected during the intended field use. They shall be colored (red for hot; black for ground).

The glove test leads shall be equipped with distinguishable connectors at each end of the "hot" and "ground" leads respectively which will be compatible with the connectors at the respective terminals to preclude accidental mistakes when connecting leads to terminals.

The test leads shall be furnished in six (6) foot lengths.

3.4.5 Protection.- The glove testing device shall be so designed that the operator shall be fully protected from electrical shock or accidents while using the glove testing device.

3.5 Carrying Cases.- The contractor shall furnish each test set housed in two integral constructed carrying cases. One case shall house the Insulating Liquids Tester while a second case shall house the glove testing device.

The cases may be wood or metal cabinet enclosures. The cases shall be equipped with removeable, hinged covers. Appropriate clamps or brackets shall be mounted in the cover portion of the tester enclosure for storing and protecting the input power cable when not in use. The case for the glove testing device shall have separate compartments for the instruction books, the test leads, the glove testing device, and the second test cup.

3.6 Instruction Books.- Two commercial quality instruction books shall be furnished with each test set which fully describe the equipment. As a minimum each instruction book shall contain the following:

- a. Manufacturers name and address
- b. General Description
- c. Theory of Operation
 - (1) Insulating Liquids Testing
 - (2) Glove Testing
- d. Operating Instructions and Parameters
 - (1) Test Procedures
 - (2) General Precautions
 - (3) Breakdown Test Precautions
 - (4) Use of Attachments
 - (5) Expected Test Values
 - (6) Effect of Humidity and Temperature on Test
- e. Schematic Diagrams
- f. Replaceable Parts List
(This list should be sufficiently detailed to permit FAA Depot procurement of electrical and electronic parts from generic sources).
- g. Maintenance Instructions
 - (1) Trouble Shooting Analysis Guide
 - (2) Cleaning of Equipment
- h. Photographs of Equipment
- i. Guarantee Clause

4. QUALITY ASSURANCE PROVISIONS

4.1 The provisions of FAA-STD-013 shall apply to insure a satisfactory quality assurance program and product conformance with the requirements of this specification.

4.2 General inspection provisions.- All tests and inspections to determine compliance with the electrical and mechanical requirements of this specification shall be made by the contractor and shall be subject to Government inspection. The term "Government inspection" as used herein, means that an FAA representative will witness the contractor's testing and inspection, and will carry out such visual and other inspection as deemed necessary to assure compliance with contract requirements. The Government reserves the right to waive Government inspection at the contractor's plant.

4.2.1 Normal test conditions.- All testing shall be done under normal operating conditions (3.2.2).

4.3 Test plan.- The test plan shall include proposed test data forms, test procedures and list of tests in accordance with FAA-STD-013, paragraph 2.2.1. Submission of copies and approval in accordance with 2.2.2.

4.4 Test data.- In accordance with FAA-STD-013, paragraph 2.2.2 for each equipment, the contractor shall furnish test data complying with the approved test plan (4.3), describing the readings or results obtained during the inspection and tests. Test data for all tests shall, where applicable, contain quantitative information. The test data must demonstrate that the equipment meets contract requirements. The original test data form shall be signed by the contractor's test man and countersigned by the Government representative, if assigned (4.2); or, if Government inspection is waived, the test data shall include the statement, "This certifies that this unit fully meets all technical requirements of the contract," and shall be dated and signed by a responsible official of the contractor.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing.- Preservation, packaging, and packing shall be in accordance with MIL-E-17555, Level "C".

5.2 Individual packing.- Where two or more units are packed in a common shipping container, each unit with its accessories shall be packed and marked so that it can be identified and reshipped individually without repacking.

6. NOTES

6.1 Note on information items.- The contents of the subparagraph below are only for the information of the government. They are not contract requirements nor binding on either the government or the contractor, except to the extent that they may be specified elsewhere in the contract as such. Any reliance placed by the contractor on the information in these subparagraphs is wholly at the contractor's own risk.

6.2 Manufacturer's literature.- The prospective bidders should be requested to submit with their proposal, their product descriptive literature on their existing commercial model on which their proposal is predicated. However, the agency's subsequent contract award to the successful bidder does not imply, in any way, the agency's pre-acceptance of the manufacturer's literature as meeting the requirements of this specification.

6.3 Additional Instruction Books.- Additional instruction books, if required, will be so stated as a separate item requirement on the Solicitation form.

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